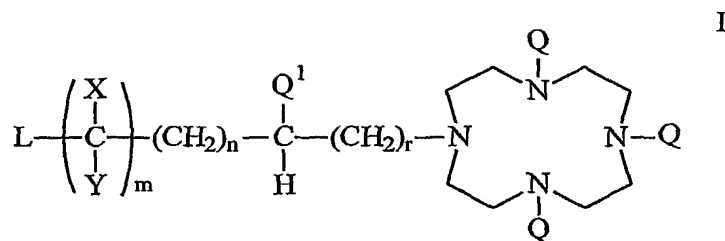


WHAT IS CLAIMED IS:

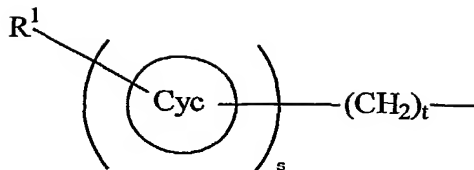
1. An ^{225}Ac complex comprising a functionalized chelant compound of the formula I

5



wherein:

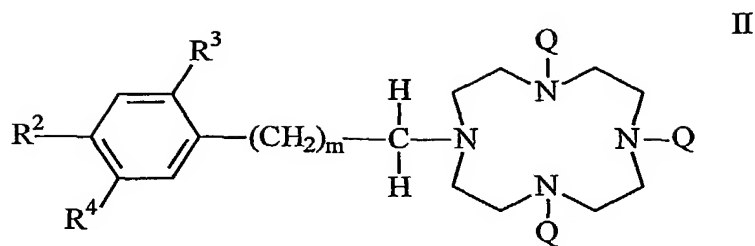
- 10 each Q is independently hydrogen or $(\text{CHR}^5)_p\text{CO}_2\text{R}$;
 Q^1 is hydrogen or $(\text{CHR}^5)_w\text{CO}_2\text{R}$;
 each R independently is hydrogen, benzyl or $\text{C}_1\text{-C}_4$ alkyl; with the proviso that at least two of the sum of Q and Q^1 must be other than hydrogen;
 15 each R^5 independently is hydrogen; $\text{C}_1\text{-C}_4$ alkyl or $(\text{C}_1\text{-C}_2 \text{ alkyl})\text{phenyl}$;
 X and Y are each independently hydrogen or may be taken with an adjacent X and Y to form an additional carbon-carbon bond;
 20 n is 0 or 1;
 m is an integer from 0 to 10 inclusive;
 p is 1 or 2;
 r is 0 or 1;
 w is 0 or 1;
 25 with the proviso that n is only 1 when X and/or Y form an additional carbon to carbon bond, and the sum of r and w is 0 or 1;
 L is a linker/spacer group covalently bonded to, and replaces one hydrogen atom of one of the carbon atoms to which it is joined, said linker/spacer group being
 30 represented by the formula



wherein

- 5 s is an integer of 0 or 1;
 t is an integer of 0 to 20 inclusive;
 R¹ is an electrophilic or nucleophilic moiety which
 allows for covalent attachment to an antibody or
 fragment of thereof, or synthetic linker which can be
 10 attached to an antibody or fragment thereof, or
 precursor thereof; and
 Cyc represents a cyclic aliphatic moiety, aromatic
 moiety, aliphatic heterocyclic moiety, or aromatic
 heterocyclic moiety, each of said moieties optionally
 15 substituted with one or more groups which do not
 interfere with binding to an antibody or antibody
 fragment;
 with the proviso that when s, t, m, r, and n are 0,
 then R¹ is other than carboxyl; or
 20 a pharmaceutically acceptable salt thereof; complexed
 with ²²⁵Ac.

2. The ²²⁵Ac complex of Claim 1 wherein the
 functionalized chelant is a compound of formula II



wherein:

5 each Q independently is hydrogen or CHR⁵COOR; with the proviso that at least two of Q must be other than hydrogen

each R independently is hydrogen benzyl or C₁-C₄ alkyl;

10 m is integer from 0 to 5 inclusive;

R² is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and maleimido;

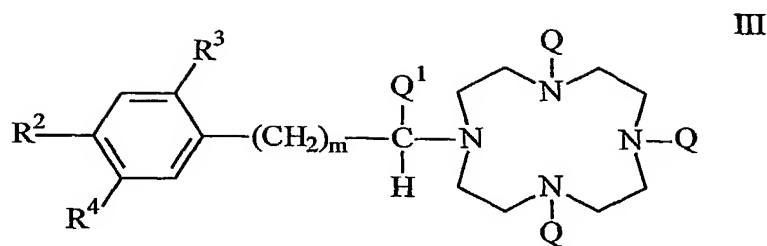
15 R³ is selected from the group consisting of C₁-C₄ alkoxy, -OCH₂COOH, hydroxy and hydrogen;

R⁴ is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and maleimido;

20 each R⁵ independently is hydrogen or C₁-C₄ alkyl; with the proviso that R² and R⁴ cannot both be hydrogen but one of R² and R⁴ must be hydrogen; or a pharmaceutically acceptable salt thereof.

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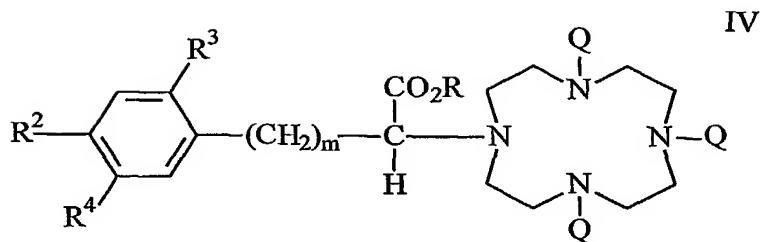
3. The ²²⁵Ac complex of Claim 1 wherein the functionalized chelant is a compound of formula III



wherein:

- 5 each Q independently is hydrogen or CHR^5COOR ;
 Q^1 is hydrogen or $(\text{CHR}^5)_w\text{CO}_2\text{R}$; with the proviso that at
 least two the sum of Q and Q^1 must be other than
 hydrogen and one Q is hydrogen;
 each R independently is hydrogen benzyl or $\text{C}_1\text{-C}_4$
 10 alkyl;
 m is integer from 0 to 5 inclusive;
 w is 0 or 1;
 R^2 is selected from the group consisting of hydrogen,
 nitro, amino, isothiocyanato, semicarbazido,
 15 thiosemicarbazido, carboxyl, bromoacetamido and
 maleimido;
 R^3 is selected from the group consisting of $\text{C}_1\text{-C}_4$
 alkoxy, $-\text{OCH}_2\text{COOH}$, hydroxy and hydrogen;
 R^4 is selected from the group consisting of hydrogen,
 20 nitro, amino, isothiocyanato, semicarbazido,
 thiosemicarbazido, carboxyl, bromoacetamido and
 maleimido;
 each R^5 independently is hydrogen or $\text{C}_1\text{-C}_4$ alkyl;
 with the proviso that R^2 and R^4 cannot both be
 25 hydrogen but one of R^2 and R^4 must be hydrogen; or
 a pharmaceutically acceptable salt thereof.

4. The ^{225}Ac complex of Claim 1 wherein the
 functionalized chelant is a compound of formula IV

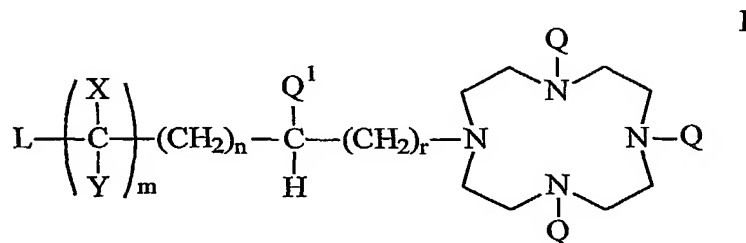


wherein:

- 5 each Q independently is hydrogen or CHR⁵COOR; with the proviso that at least one Q must be other than hydrogen;
- each R independently is hydrogen benzyl or C₁-C₄ alkyl;
- 10 m is integer from 0 to 5 inclusive;
- R² is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and maleimido;
- 15 R³ is selected from the group consisting of C₁-C₄ alkoxy, -OCH₂COOH, hydroxy and hydrogen;
- R⁴ is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and
- 20 maleimido;
- each R⁵ independently is hydrogen or C₁-C₄ alkyl; with the proviso that R² and R⁴ cannot both be hydrogen but one of R² and R⁴ must be hydrogen; or a pharmaceutically acceptable salt thereof.

25 5. The ²²⁵Ac complex of Claim 1 wherein the functionalized chelant compound is 1-[(2-methoxy-5-isothiocyanatophenyl)-carboxymethyl]-4,7,10-triscarboxymethyl-1,4,7,10-tetraazacyclododecane (MeO-DOTA-NCS).

6. An ^{225}Ac conjugate comprising a functionalized chelant compound of the formula I



5

wherein:

each Q is independently hydrogen or $(\text{CHR}^5)_p\text{CO}_2\text{R}$;

Q^1 is hydrogen or $(\text{CHR}^5)_w\text{CO}_2\text{R}$;

10 each R independently is hydrogen, benzyl or $\text{C}_1\text{-C}_4$ alkyl; with the proviso that at least two of the sum of Q and Q^1 must be other than hydrogen;

each R^5 independently is hydrogen; $\text{C}_1\text{-C}_4$ alkyl or $(\text{C}_1\text{-C}_2 \text{ alkyl})\text{phenyl}$;

15 X and Y are each independently hydrogen or may be taken with an adjacent X and Y to form an additional carbon-carbon bond;

n is 0 or 1;

m is an integer from 0 to 10 inclusive;

20 p is 1 or 2;

r is 0 or 1;

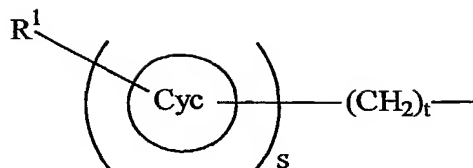
w is 0 or 1;

with the proviso that n is only 1 when X and/or Y form an additional carbon-carbon bond, and the sum of r and w is 0 or 1;

25

L is a linker/spacer group covalently bonded to, and replaces one hydrogen atom of one of the carbon atoms to which it is joined, said linker/spacer group being represented by the formula

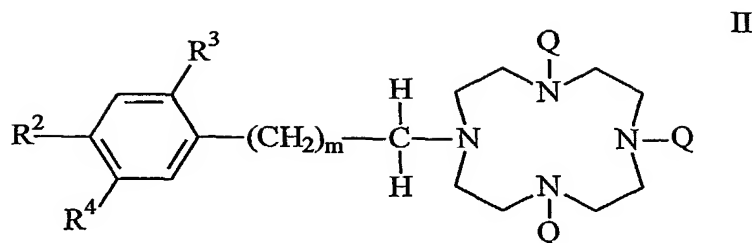
30



wherein

- 5 s is an integer of 0 or 1;
 t is an integer of 0 to 20 inclusive;
 R¹ is an electrophilic or nucleophilic moiety which
 allows for covalent attachment to an antibody or
 fragment of thereof, or synthetic linker which can be
 10 attached to an antibody or fragment thereof, or
 precursor thereof; and
 Cyc represents a cyclic aliphatic moiety, aromatic
 moiety, aliphatic heterocyclic moiety, or aromatic
 heterocyclic moiety, each of said moieties optionally
 15 substituted with one or more groups which do not
 interfere with binding to an antibody or antibody
 fragment;
 with the proviso that when s, t, m, r, and n are 0,
 then R¹ is other than carboxyl; or
 20 pharmaceutically acceptable salt thereof;
 complexed with ²²⁵Ac; and covalently attached to a
 biological molecule.

7. The ²²⁵Ac conjugate of Claim 6 wherein the
 25 functionalized chelant is a compound of formula II

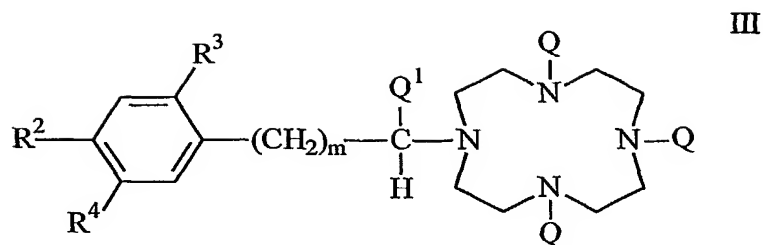


wherein:

- 5 each Q independently is hydrogen or CHR⁵COOR; with the proviso that at least two of Q must be other than hydrogen
 each R independently is hydrogen benzyl or C₁-C₄ alkyl; .
- 10 m is integer from 0 to 5 inclusive;
 R² is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and maleimido;
- 15 R³ is selected from the group consisting of C₁-C₄ alkoxy, -OCH₂COOH, hydroxy and hydrogen;
 R⁴ is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and maleimido;
- 20 each R⁵ independently is hydrogen or C₁-C₄ alkyl; with the proviso that R² and R⁴ cannot both be hydrogen but one of R² and R⁴ must be hydrogen; or a pharmaceutically acceptable salt thereof.

25

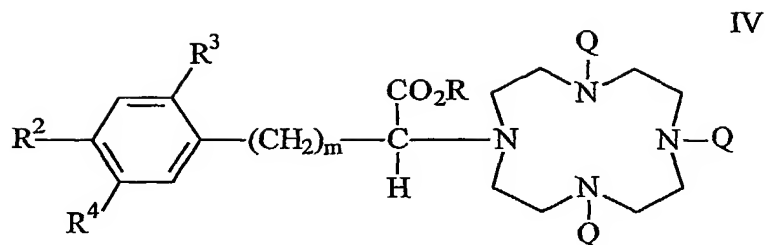
8. The ²²⁵Ac conjugate of Claim 6 wherein the functionalized chelant is a compound of formula III



wherein:

- 5 each Q independently is hydrogen or CHR^5COOR ;
 Q^1 is hydrogen or $(\text{CHR}^5)_w\text{CO}_2\text{R}$; with the proviso that at
 least two the sum of Q and Q^1 must be other than
 hydrogen and one Q is hydrogen;
 each R independently is hydrogen benzyl or $\text{C}_1\text{-C}_4$
 10 alkyl;
 m is integer from 0 to 5 inclusive;
 w is 0 or 1;
 R^2 is selected from the group consisting of hydrogen,
 nitro, amino, isothiocyanato, semicarbazido,
 15 thiosemicarbazido, carboxyl, bromoacetamido and
 maleimido;
 R^3 is selected from the group consisting of $\text{C}_1\text{-C}_4$
 alkoxy, $-\text{OCH}_2\text{COOH}$, hydroxy and hydrogen;
 R^4 is selected from the group consisting of hydrogen,
 20 nitro, amino, isothiocyanato, semicarbazido,
 thiosemicarbazido, carboxyl, bromoacetamido and
 maleimido;
 each R^5 independently is hydrogen or $\text{C}_1\text{-C}_4$ alkyl;
 with the proviso that R^2 and R^4 cannot both be
 25 hydrogen but one of R^2 and R^4 must be hydrogen; or
 a pharmaceutically acceptable salt thereof.

9. The ^{225}Ac conjugate of Claim 6 wherein the
 functionalized chelant is a compound of formula IV



wherein:

- 5 each Q independently is hydrogen or CHR⁵COOR; with the proviso that at least one Q must be other than hydrogen;
- each R independently is hydrogen, benzyl or C₁-C₄ alkyl;
- 10 m is integer from 0 to 5 inclusive;
- R² is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and maleimido;
- 15 R³ is selected from the group consisting of C₁-C₄ alkoxy, -OCH₂COOH, hydroxy and hydrogen;
- R⁴ is selected from the group consisting of hydrogen, nitro, amino, isothiocyanato, semicarbazido, thiosemicarbazido, carboxyl, bromoacetamido and maleimido;
- 20 each R⁵ independently is hydrogen or C₁-C₄ alkyl; with the proviso that R² and R⁴ cannot both be hydrogen but one of R² and R⁴ must be hydrogen; or a pharmaceutically acceptable salt thereof.

25

10. The ²²⁵Ac conjugate of Claim 6 wherein the functionalized chelant compound is 1-[(2-methoxy-5-isothiocyanatophenyl)-carboxymethyl]-4,7,10-triscarboxymethyl-1,4,7,10-tetraazacyclododecane (MeO-DOTA-NCS).

30

11. The ^{225}Ac conjugate of any one of Claims 6 to 10 wherein the biological molecule is an antibody or antibody fragment.

5 12. The ^{225}Ac conjugate of any one of Claims 6 to 10 wherein the biological molecule is selected from the group of antibodies consisting of NuM195, CC-49, CC-49 F(ab')₂, CC-83, and CC-83 F(ab')₂.

10 13. The ^{225}Ac conjugate of Claim 6 wherein the functionalized chelant compound of the conjugate is 1-[(2-methoxy-5-isothiocyanatophenyl)-carboxymethyl]-4,7,10-triscarboxy-methyl-1,4,7,10-tetraazacyclododecane and the biological molecule is selected from the group of
15 antibodies consisting of HuM195, CC-49, CC-49 F(ab')₂, CC-83, and CC-83 F(ab')₂.

14. The ^{225}Ac conjugate of Claim 13 wherein the functionalized chelant compound of the conjugate is 1-[(2-
20 methoxy-5-isothiocyanatophenyl)-carboxymethyl]-4,7,10-triscarboxy-methyl-1,4,7,10-tetraazacyclododecane and the biological molecule is HuM195 antibody.

15. A pharmaceutical formulation comprising the ^{225}Ac
25 conjugate of any one of Claims 6 to 10 with a pharmaceutically acceptable carrier.

16. A pharmaceutical formulation comprising the ^{225}Ac
30 conjugate of Claim 12 with a pharmaceutically acceptable carrier.

17. A pharmaceutical formulation comprising the ^{225}Ac
conjugate of Claim 13 or Claim 14 with a pharmaceutically acceptable carrier.

18. A method of the therapeutic treatment of a mammal having cancer which comprises administering to said mammal a therapeutically effective amount of a pharmaceutical formulation of Claim 15.

5

19. A method of the therapeutic treatment of a mammal having cancer which comprises administering to said mammal a therapeutically effective amount of a pharmaceutical formulation of Claim 16.

10

20. A method of the therapeutic treatment of a mammal having cancer which comprises administering to said mammal a therapeutically effective amount of a pharmaceutical formulation of Claim 17.